CHAPTER 1

INTRODUCTION

1.1 Introduction to Thesis

The purpose of this thesis is to conduct a study about the flexural strength of rectangular beam using polystyrene beads as course aggregate. All the steps and procedure are shown in this thesis. At the end of this research, all the objectives should be answered and proved. If the testing result is slightly different from the theoretical or expected, the reasons are stated in the discussion.

1.2 Introduction to Lightweight Concrete

For over fifty years, there are many attempts to overcome the disadvantages of concrete in making building. Concrete is well known as heavy, rigid and its thermal and acoustical quality is not very high. In order to overcome this issue, one of the ways is by replacing aggregate of concrete, sand or gravel with lighter materials. First natural products were utilized such as corn, pumice, schist, cork, pozzuoluna and woods. Later knowledge and insulation concerns more materials were used including expanded clay, vermiculite, expanded glass, aluminum, expanded rock and expanded polystyrene (EPS). Polystyrene is best known for its efficiency, cost-effectiveness and lightweight. Polystyrene meets all the requirement of economical packaging and consequently its waste mounted day after day. Polystyrene is vinyl polymer produced by free radical vinyl polymerization. While expandable Polystyrene (EPS) is polystyrene in raw beads being steam-heated, causing it to expand and forming a cellular structure. They are many names for polystyrene such as

“styropor” and mainly used as insulating materials. The beads are inelastic so they do not recover when deformed but still able to withstand the stresses when the concrete is mixed.

Lightweight concrete (LWC) being one of the choices in construction industry because of its advantage in terms of economic and also it is practical. It is convenient to categorize the various types of lightweight concrete by their method of production. These are; (i) by using porous lightweight aggregate of low apparent specific gravity. (ii) By introducing large voids within the concrete or mortar mass. (iii) By leave the fine aggregate from the mix so that a large number of interstitial; voids are present; normal weight course aggregate is generally used.

Lightweight concrete also has a small density compare to normal concrete because of the presence of voids. Obviously, it is clear that the presence of these voids will leads to decreasing in strength of lightweight concrete compared with normal weight concrete. Furthermore, it will reduce the cost of formwork and steel and also increase productivity. Concrete which has lower density also gives better thermal insulation compare to normal concrete. Many lightweight concrete has been produced by using lightweight aggregates (LWA) and artificial aggregate such as fly ash, slag and porcelinite rocks and mostly the process of manufacturing lightweight concrete is costly. This leads to using polystyrene beads as an alternative way. Polystyrene beads are choosing because of its light density about (16-27) kg/m^3, good thermal energy absorbing characteristics and good thermal insulator. Some researchers conduct the study about the structural, physical and mechanical behavior of polystyrene concrete. During the manufacturing of polystyrene concrete, they avoided vibration and compact their mixes by hand tamping. This is done to reduce the segregation of polystyrene beads because of its low density.

So, the main objectives to carried out this experiment is to use polystyrene beads to produce special type of concrete mixture characterized by high resistance to segregation that can be cast without compaction or vibration due to compacted self-weight. Polystyrene concrete is a lightweight concrete made with expanded polystyrene beads usually known for its good thermal and caustic insulation properties. Several researchers that studied the

properties of polystyrene concrete like density, compressive and flexural strength, dynamic modulus of elasticity and thermal conductivity. This results show that the properties are affected by the polystyrene concrete and decreases with increase the polystyrene cement ratio.

A study of concrete using polystyrene beads as replacement of course aggregate was carried out by Park and Chisholm [3]. Three different density were conducted and at each density, mixes both with and without fly ash were examined. It was found that the polystyrene concrete is very prone to segregation and also it has a low compressive strength. It also has relatively high drying shrinkage. For thermal conductivity testing showed that the lighter the concrete, the lower the thermal conductivity. By adding flying ash to the mixes, it will decreased the water demand thus, the density and shrinkage but also caused a significant compressive strength reduction. While Sussman [9] concluded that the mechanical properties of polystyrene concrete is increase with the increase of density and these properties are controlled by the water to cement ratio. Maura [10], also produced polystyrene concrete with densities between (220-460) kg/m^3 and compressive strength between (0.7-2.3)MPa, while modulus of rapture was between (0.3-0.36)MPa. Ismail[4] studied the properties of hardened concrete bricks containing polystyrene beads and he found that polystyrene concrete is very prone to segregate where placing and compacting can be quite difficult using vibratory compaction techniques. He also found that polystyrene concrete bricks with densities less than $1800kg/m^3$ have very low strength which is suitable to use as load bearing internal wall.

Flexural strength also known as modulus of rupture, bend strength or fracture strength. Flexure tests are generally used to determine the flexural modulus or flexural strength of a material. For method of testing, we used four point load method to test the flexural test. The four points bending flexural test provides values for the modulus of elasticity in bending, flexural stress, flexural strain and the flexural stress-strain response of the material. The main advantage of a four point flexural test is the ease of the specimen preparation and testing. Flexure test is run until the sample experiences failure and is therefore ideal for the testing of brittle materials. The most common materials tested in